

Quantum Field Theory for Philosophers

Revised summary version

Note Date Oct 1982

Introduction

- 1) QFT as a guide to metaphysics
- Broad of interpretive problem of OM
- 2) Classical concept of field ^{per se}
Field v. particle theory _{assumes completeness of QFT description} slide 1
- 3) What do we mean by an individual? - TI.
- spatio-temporal content of trajectory, but in QM it is indeterminate
- 4) Field approach to classical particle physics - slide 2
Newton 'On the Gravity and Equilibrium of Fluids'
- 5) Quantum Field Theory

Two approaches: Field quantization } slide 7
Second quantization }

Field Underdetermination Thesis
Field quantization - slide 18 (19)
Basic report of QFT - slide 30

Creation/annihilation operators - slide 20
→ in 2nd quantization slide 21

- 6) Q Quantum Field from animal in 2 cases.

- Reprises
- 1) Real field v. complex field
 - 2) Born - Dirac field limit. ||
v. Fermi - Dirac particle limit
 - 3) non-relativistic (Poisson) v. relativistic
 - 4) Weyl's programme.

can be formulated
in particle approach → 5) Gravity conditions - slide 29
Sufficient condition: Born or Fermi
→ per field theory → 5th Newton's Theorem slide 29

7) Creation / annihilation particles in classical mechanics slide (17) and (18)

Islamic 9:00 AM - Mufakholomun 12th P. Mainmomen

25 min
8) Wave - particle duality Subfield of all equivalent repeat. No. does not calculate with $\psi(x, t)$ and $\phi(x, t)$.

slide (22)
Dust Quanta {Ex has a choice}
A complete Ramsey lecture to work on light-quantum description of the interaction [between class and abstract words]

30 min
9) Matter & Fields slide (12)

of Redshift phenomena, say stars, C.V.T.S., supergravity, Unification of general relativity.

35 min
[10] What do we mean by verification?
F/H v. say they verification?

11) The Problem of Inductuality

Elem. particles do not possess TI \therefore re-included.
Stat. Mechanics argument - slide (13), (14).
40 min
limitation on accessibility of states if TI is assumed.

Vacuum and Virtual Particles

12.) Vacuum $\rho_0 = 0$ fluctuations in $|\Omega\rangle$ explain Lamb shift - Common effect of extended particle interpretation.

add (23)

45 min

13.) Virtual particles

Expand $|\Phi\rangle$ in $|\Phi\rangle + \dots$
 virtual particles

$H_0 + H'$ start in terms of H_0 relations

add (16)

- Internal lines of Feynman diagrams

- no direct connection with vacuum fluctuations, which do not require interaction

14.) Conclusion we have argued for a formal theory of underdetermination as between field and particle approaches to the elementary particles.

But there are extra logical arguments for preferring the field approach.

- Any philosophical argument against TI tells against the particle approach
- Heuristic value of field theory - in particle approach field quantities are very confused and hard to interpret

We introduced two broad metaphysical categories

Continuants reinterpreted through time by TI

Ephemerals Distinguishable at a just time but not identifiable if relations of spatio-temporal continuity apply.

Final Remark

Although classical wave configurations are examples of ephemerals this does not mean that the elementary 'particles' are just waves. We have argued that they do not possess TI. So the substantial aspect of 'particles' is lacking for the elementary 'particles' in the philosophical sense of substantial. But like the Cheshire cat, although the substantial particularity has gone, there remains a particle grin. The elementary 'particles' are not particles but they are also not classical-type fields. They are quantum fields - ephemerals with a particle grin. And if you want me to stick my neck out this is the ultimate nature of reality according to modern theoretical physics

50 min